



Severe facial rubber bullet injuries: Less lethal but extremely harmful weapons

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ABSTRACT

Less-lethal rubber-bullet weapons are designed to induce blunt injuries that incapacitate violent individuals.

Aim and scope: We intend to study the functional and aesthetic impairments and the cost in terms of social health resulting from rubber-bullet facial trauma.

Materials and methods: We retrospectively collected all the facial trauma cases caused by mass-appearance, less-lethal guns followed up in two French university hospitals since the year 2000. We did not consider the facial injuries caused by professional, less-lethal, rubber or plastic bullet guns.

Conclusion: We showed that mass-appearance, less-lethal rubber-bullet guns induce severe traumas with irreversible functional consequences and long-term social implications. Victims of facial rubber-bullet traumas should be managed like high-energy trauma patients and benefit from extremely careful primary wound care.

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Self-defence guns are designed to provide high stopping power without inducing severe injuries. The British forces first used such weapons in 1970 in Northern Ireland.⁵ In order to be less harmful, rubber bullets have to be fired according to strict rules. These rules can nevertheless hardly be respected by inexperienced persons in stressful conditions.^{2,4}

The sales of mass-appearance, less powerful versions of professional rubber-bullet guns are poorly regulated in the European Union (EU). Facial trauma caused by such defence weapons is an important issue because of the major functional risks and the possible aesthetic sequellae. Since the year 2000, six patients were treated for rubber-bullet facial trauma in the maxillofacial surgery departments of two French university hospitals. We excluded the trauma cases caused by professional rubber-bullet guns used by the army or the police. The aim of the study was to estimate the functional, aesthetic and financial consequences of such injuries.

Materials and methods

We considered all the patients admitted to the maxillofacial surgery departments of two French university hospitals for the treatment of facial injury due to rubber-bullet trauma from 2000 to

2008. We only considered the cases where the trauma had been caused by mass-appearance weapons. Trauma induced by professional weapons used by the police or the army has been excluded. The following clinical data were collected: gender, age at trauma, circumstances of trauma, types of weapon and ammunition, pattern of injury, type of primary surgery, hospitalisation duration, occurrence of infection, secondary surgeries and sequellae.

Results (Table 1)

Six patients (three males and three females, ages: 20–48 years) matched the selection criteria. In five cases, the gun had been used as an attack weapon. In one case, the trauma occurred in a self-defence situation.

The weapon was identified in five cases as GC27 or GC54, standard French less-lethal rubber-bullet guns manufactured by SAPL (Société d'Application des Procédés Lefèvre, Le Biot, Gauville, France). The GC27 is a 12-gauge, single-shot, smooth-bore 580 g handgun with a 70-mm barrel and a 50-mm chamber handling 12/50 bullets. The GC54 is the double-shot equivalent of the GC27 and has similar technical characteristics.

Two types of ammunition were used in the reported cases. *Fun-Tir* (FT, *Fun-Shot* in English) is a 12-gauge 50-mm cartridge containing 1.19 g of black powder, a 1.77 g wad and an 18-mm spherical rubber bullet weighing 4.48 g. The total weight of the missile is thus 6.25 g, propelled at a kinetic energy of 23.98 J at 1 m.

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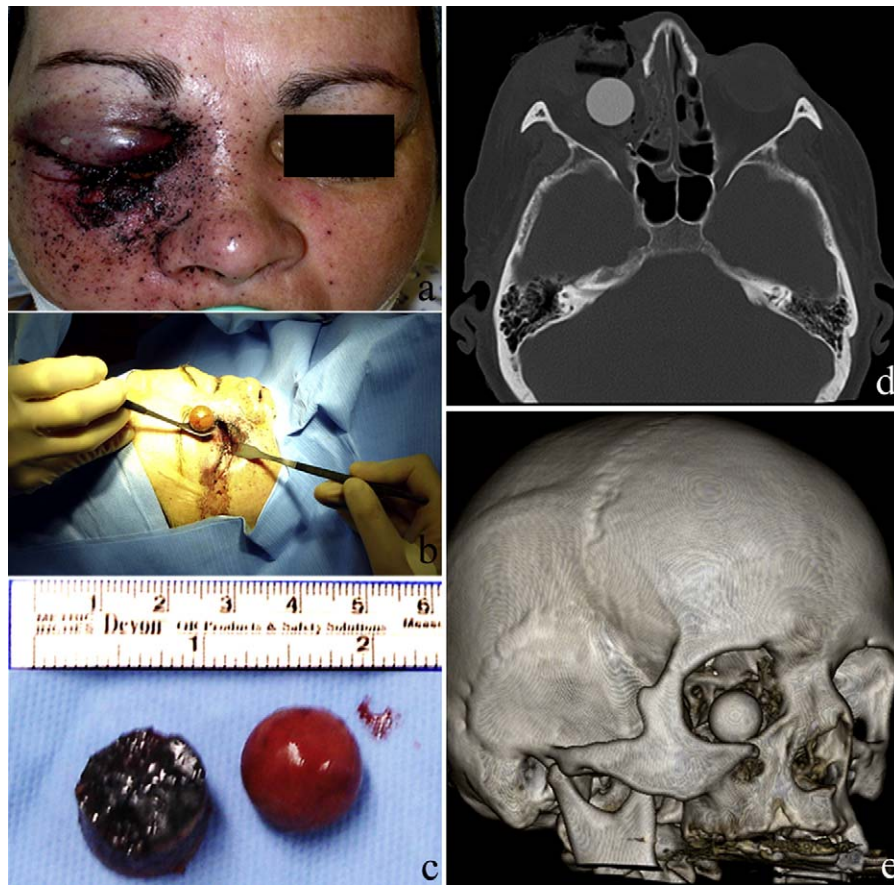


Fig. 1. Case #1: (a) patient at admission, with extensive traumatic gunpowder tattoo and penetrating injury of the internal canthus; (b and c) the 18-mm rubber missile and the wad were extracted from the orbit; (d) the medial wall of the orbit and the right ethmoidal cells were fractured—the wad was visible anterior prior to the bullet; (e) 3D CT-scan showing the infero-medial intra-orbital localisation of the rubber bullet; right zygoma and orbital floor fractures.

The mean velocity of *FT* calculated on 10 shots (bullet and wad) is $87.6 \pm 7.8 \text{ m s}^{-1}$.⁷ *Mini-Gomm-Cogne* (*mGC*, *Mini-Rubba-Bang* in English) is a 12-gauge 50-mm cartridge containing 2.44 g of black powder, a 1.43 g wad and twelve 7.4-mm spherical rubber pellets weighting 0.33 g each. A 0.36-g crimp shuts the cartridge. The total weight of the missile is thus 5.39 g, propelled at a kinetic energy of 49.77 J at 1 m. The mean velocity of *mGC* calculated on 10 shots (bullet and wad) is $135.9 \pm 4.6 \text{ m s}^{-1}$.⁷

Two patients were shot in the eye, two patients on the cheek and one on the forehead. All six patients were hospitalised and managed like high-energy trauma patients. One patient could be discharged in less than a week.

Traumatic skin tattoo was found in four cases; these patients were thus shot point blank or at extremely short ranges. All patients presented with penetrating injuries. Three cases had zygomatic and orbital fractures; one case had zygomatic and multi-fragmented mandibular fractures. Two patients had permanent damage of an eye globe. Nerve lesions – right V_2 trigeminal nerve and right facial nerve – were found in two cases.

We performed primary surgery in four cases with careful wound care and bullet extraction. Two cases had been referred for secondary surgery. Osteosynthesis of the orbital rim with orbital floor reconstruction using absorbable material were performed in two cases. One patient benefited from mandibular osteosynthesis.



Fig. 2. Case #2: (a) 3 weeks after initial surgery: severe right periorbital pain, purulent rhinorrhea and epiphora; (b) right orbital floor fracture and wad inserted into the right maxillary sinus; (c) extraction of the wad during secondary surgery; orbital floor reconstruction was delayed.

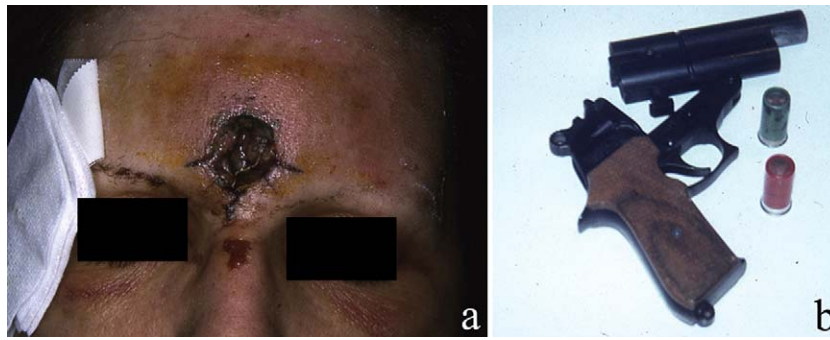


Fig. 3. Case #3: (a) frontal non-penetrating wound with traumatic tattoo; (b) incriminated weapon: SAPL GC54.

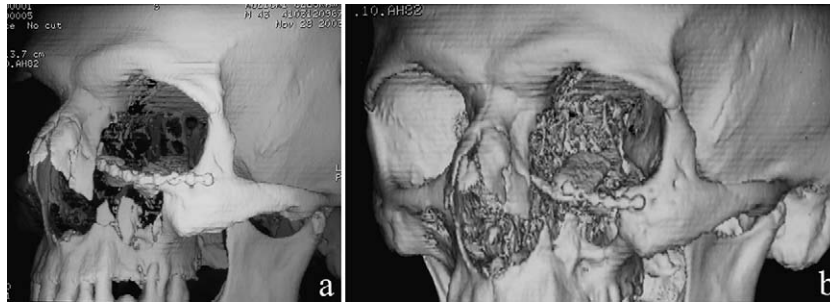


Fig. 4. Case #5: (a) initial orbital reconstruction using a microplate on the rim and a absorbable plate for the floor; (b) secondary orbital floor reconstruction using a parietal bone graft.

Infection occurred in four cases: purulent sinusitis in two cases and jugal subcutaneous abscess in two cases. In all infected cases, secondary surgery revealed fragments of wad not seen during primary wound care. Infection relapsed after foreign-body extraction and broad-spectrum antibiotherapy.

All patients benefited or will benefit from secondary surgery after primary wound care. Apart from secondary wad extraction in four cases, two patients will undergo prosthetic eye replacement, one patient benefited from a two-step orbital floor reconstruction (first using absorbable material then parietal bone graft due to

Table 1

Clinical characteristics, treatment and outcome. FT: *Fun-Tir*; mGC: *mini-Gomm-Cogne*.

Gender	Age	Circumstance	Weapon	Ammunition	Hospitalisation	Penetration point	Performed surgeries	Infection	Sequellae	Planned surgeries
F	48	Criminal assault during duty near Nantes (bus driver)	GC27	FT	>1 week	Right lower eyelid	Eyeball suture, orbital rim osteosynthesis, orbital floor prosthetic replacement, lower eyelid suture, periorbital dermabrasion (Fig. 1)	No	Eye loss, severe scarring (lower eyelid)	1. Prosthetic eye replacement 2. Mustardé flap for lower eyelid reconstruction
M	20	Self-defence during a fight in the West-Indies	GC54	mGC	>1 week	Right eye	1. Right eyeball evisceration and wound care 2. Secondary wound care with wad extraction after three weeks (Fig. 2)	Yes	Eye loss, severe scarring	1. Prosthetic eye replacement 2. Orbital floor reconstruction
F	45	Criminal assault in greater Paris	GC54	mGC	<1 week	Forehead	1. Primary wound care 2. Secondary H-flap (Fig. 3)	No	Severe scarring	-
F	45	Criminal assault in greater Paris	GC27	mGC	>1 week	Right cheek	1. Primary wound care 2. Secondary wad extraction	Yes	Severe scarring	Scar revision
M	43	Criminal assault in greater Paris	GC27	FT	>1 week	Left cheek	1. Primary wound care 2. Orbital rim osteosynthesis 3. Prosthetic orbital floor replacement 4. Repeated right maxillary sinus drainages 5. Secondary orbital floor reconstruction using parietal bone (Fig. 4)	Yes	Severe scarring	Scar revision
M	44	Terrorist attack in Algeria	?	mGC	>1 week	Right cheek	1. Primary wound care 2. Secondary wad extraction and osteosynthesis of the mandible	Yes	Facial paralysis, severe scarring	1. Scar revision 2. Facial nerve repair

persistent defect) and two patients had local H-flap and Mustardé flap for forehead and lower eyelid reconstruction, respectively.

Discussion

Our results confirm that mass-appeal self-defence guns can induce extremely severe facial injuries. Nevertheless, these weapons are designed to avoid penetrating injuries, even at short ranges. A recent ballistic study using the *SAPL GC27* with *Fun-Tir* missiles has in fact shown that pectoral points of impact induced only rib fractures when the firing range was less than 2 m.⁷ According to the manufacturers, in order to minimise the risks of penetration, users are advised to respect a critical 'safety firing distance' and should never aim at the face.

Interestingly, repeated reports have shown that even trained professionals are unable to respect the safety instructions: in stressful and stormy conditions, aiming at lower extremities and keeping a critical firing distance is impossible.^{2,4} Moreover, several injury pattern studies have underlined the uncontrollable dispersion of less-lethal ammunition: beyond a critical distance depending on the weapon type, the face can be hit even when the lower extremities are aimed at.^{1,3,8}

We report five cases where the misuse of self-defence guns as an attack weapon has led to permanent and extremely severe facial injuries, necessitating long-term hospitalisation and two- to three-step surgical treatments. Similar dramatic outcome occurred in the single case where the weapon had been used in a strictly self-defensive situation.

Regarding the poor ballistic reliability of the gun, and the numerous circumstances where it can be misused, we believe that defining clear rules such as 'safety distances' is irrelevant as far as the face is concerned.

SAPL GC27 and *SAPL GC54* are less-lethal weapons legally registered in France in the '7th category, I, 3rd paragraph': the guns are thus available for sale over the counter in gunsmith shops without permit to any adult (over 18) producing a valid ID, a medical certificate of mental health and able to provide an address for official registration. The only instrument at the EU level concerning civil weapons is the directive 1991/477/EEC, on control of the acquisition and possession of firearms, which has been partly amended by the directive 2008/51/EC; but these legislative instruments only refer to proper firearms, essentially the ones detained by hunters and marksmen. There are no prospects of legislating at the EU level on self-defence rubber-bullet guns.

The *SAPL GC27* and *GC54*, with their toy-like designs and the fancy names of their missiles, are much less powerful than the rubber-bullet guns used by the French police forces, such as the *Flash-Ball Pro*®. These guns are nevertheless extremely harmful when handled by average citizens.⁶ Our case reports call for an urgent reconsideration of the sales regulation of the *GC27* and *GC54* in France and hopefully in the EU, as the criminal use of the gun is now within anyone's mean. Less-lethal weapons cannot be considered solely as defence weapons.

The misuse of self-defence weapons has a very high social cost. We report the case of a 48-year-old bus driver who was shot point blank by a robber in the right eye during her duty. The French social services recognise a 25% work disability after the loss of one eye. This patient will not be able to work as a driver until her retirement and will be taken in charge by her insurance company for approximately 10 years. Financial considerations should encourage change in the sales regulation of weapons such as the *GC27* and the *GC54*.

An important technical issue is the surgical removal of the wad when the patient is shot point blank. It is sometimes extremely difficult to find pieces of cardboard and fibrous material in bleeding tissues. Nevertheless, if the initial wound care is not careful, as seen in four of the reported cases, secondary infection is unavoidable.

Conflict of interest

All authors disclose any financial and personal relationships with other people, or organisations, that could inappropriately influence (bias) their work, all within 3 years of the beginning the work submitted.

References

1. Cohen MA. Plastic bullet injuries of the face and jaws. *S Afr Med J* 1985;68:849–52.
2. Hiss J, Hellman FN, Kahana T. Rubber and plastic ammunition lethal injuries: the Israeli experience. *Med Sci Law* 1997;37:139–44.
3. Lavy T, Abu Asleh S. Ocular rubber bullet injuries. *Eye* 2003;17:821–4.
4. Mahajna A, Aboud N, Harbaji I, et al. Blunt and penetrating injuries caused by rubber bullets during the Israeli-Arab conflict in October, 2000: a retrospective study. *Lancet* 2002;359:1795–800.
5. Millar P, Rutherford WH, Johnston S, Malhotra VJ. Injuries caused by rubber bullets: a report on 90 patients. *Br J Surg* 1975;62:480–6.
6. Voiglio EJ, Fanton L, Caillot JL, et al. Suicide with 'non-lethal' firearm. *Lancet* 1998;352:882.
7. Voiglio EJ, Frattini B, Dörrzapf JJ, et al. Ballistic study of the *SAPL GC27* gun: is it really 'nonlethal'? *World J Surg* 2004;28:402–5.
8. Wahl P, Schreyer N, Yersin B. Injury pattern of the *Flash-Ball*®, a less-lethal weapon used in law enforcement: report of two cases and review of the literature. *J Emerg Med* 2006;31:325–30.